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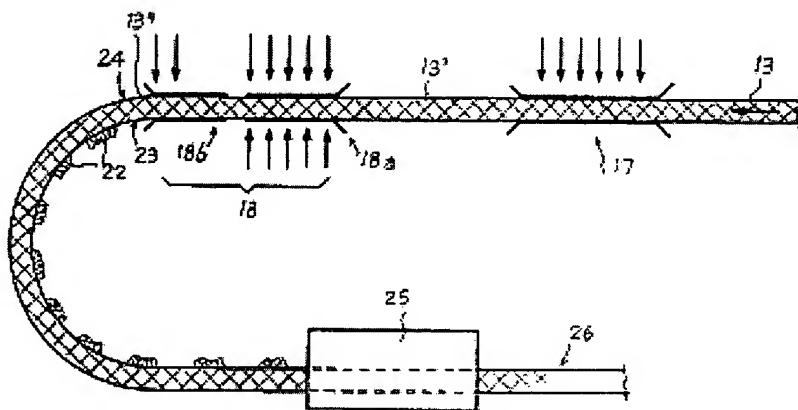
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(54) Female part of a self-gripping fastener made of a nonwoven, procedure for its manufacture, and the grip-fastener thus obtained

(57) The material, which is intended to form the female part of a self-gripping fastener, consists of a needle-punched and thermobonded nonwoven that is composed of a mixture of fibers having an average length of at least 50 mm, with a proportion of at least 20% thermobonding fibers, and that has, on one surface, loops formed during the needle-punching.

The manufacturing procedure consists of:

- a) forming a web of fibers [13] starting from a mixture containing a predetermined proportion of thermobonding fibers;
- b) needle-punching the said web using conventional needles for the consolidation of the web and with fork needles or crown needles for the formation of loops [22] on the surface, and
- c) heat-treating the needle-punched web, without calendering, at a temperature high enough to produce the superficial melting of the thermobonding fibers.



FIG_5

Descriptive specification

The present invention relates to the field of self-gripping fasteners, which are well known, particularly under the name Velcro, and which include two parts that are usually in the form of two strips, one of which carries gripping elements, of the hook, harpoon, or nail-head type, and the other of which carries elements suitable for being gripped by the first elements, and that are usually in the form of loops. The present invention relates more specifically to a material intended to constitute the female part of a self-gripping fastener, intended in particular for use in consumable products such as disposable diapers.

In the present text, the term "self-gripping fastener" is used broadly, with inclusive reference to the instance in which the two strips equipped respectively with the male and female elements are incorporated into the parts of a single article, which parts are joined to one another so as to constitute the fastener of the said article, such as, for example, an article of wearing apparel, or a piece of footwear, and also includes the instance in which there is no fastener *per se* for an article, but rather simply the joining of two different parts, each of which is provided, respectively, with suitable self-gripping male and female elements.

The self-gripping fasteners, particularly the ones known as Velcro, have now found very diverse applications, in articles of wearing apparel, furnishings, footwear, leisure items, etc. They have the advantage of a very simple implementation for obtaining the fastening, through the simple application of two strips to each other; a very high degree of resistance to separation under traction in the plane of the two strips; and a high capacity for reuse without excessive deterioration of the hooking elements. Naturally, the structure and composition of the hooking elements reflect the intended use.

The female strip of a self-gripping fastener is usually made of a knitted fabric, such as jersey, that has undergone a finishing operation such as brushing or scraping, in order to release a certain number of surface filaments so as to form loops.

Such a material is described, in particular, in French standard No. NFG 91-101.

The cost of manufacturing of such a material, including a knitting operation and a finishing operation, is high, and is scarcely compatible with the use of this material in a relatively inexpensive and limited-use product such as a disposable diaper. It is also known that in a certain number of applications, it is not strictly necessary for the fastener to have a high capacity for reuse. It is simply necessary for the fastener to be

reusable one or a few times with no deterioration, but with sufficient resistance to traction in the plane of the two strips.

The goal set by the present applicant was to provide a material, intended to form the female part of a self-gripping fastener, that meets this need.

This goal is met conclusively by the material according to the invention, which, in a characteristic manner, consists of a needle-punched and thermobonded nonwoven that is composed of a mixture of fibers having an average length of at least 50 mm, with a proportion of at least 20% thermobonding fibers, and that has, on one surface, loops formed during the needle-punching.

The loops extending outward from the surface of the nonwoven are suitable for being gripped by the male elements of the fastener. The average length of the fibers, which is at least 50 mm, and the presence of the thermobonding fibers make it possible to obtain a satisfactory anchoring of the ends of the loops, so as to limit the defibration of the loops during use.

The mechanical strength of the hooking action, and thus the efficiency of the self-gripping principle, is a function of the titer of the fibers employed in the nonwoven. The mean titer is preferably between 1.7 and 17 dtex, depending on the surface mass of the nonwoven.

The average length of the fibers is preferably between 60 and 100 mm.

In a preferred variant of one embodiment, the nonwoven has a surface mass on the order of 100 grams/m²; the mean titer of the fibers is on the order of 4.5 dtex; and the proportion of the fibers in the mixture is on the order of 30% copolyester fibers and 70% polyester fibers.

For a given surface mass, it may be advantageous for a certain proportion of fibers to have a low titer, so as to achieve better coverage of the nonwoven.

Another goal of the invention is to provide a specially designed procedure for the manufacture of a material having a base of a needle-punched, thermobonded nonwoven intended to form the female part of a self-gripping fastener.

In a characteristic manner, this procedure consists of:

- a) forming a web of fibers starting from a mixture containing a predetermined proportion of thermobonding fibers;

- b) needle-punching the said web using conventional needles for the consolidation of the web and using fork needles or crown needles for the formation of loops on the surface, and
- c) Heat-treating the needle-punched web, preferably without calendering, at a temperature high enough to produce the superficial melting of the thermobonding fibers.

When the fork needle penetrates the fiber web, one fiber (or more) is lodged in the needle slot and is drawn along by this slot. Similarly, upon penetration of the crown needle, one fiber (or more) is lodged in each of the three notches provided in a circular arrangement near the end of the needle, and is drawn along by the notch. The penetration of the needle is sufficient to cause the fiber in question to be pushed beyond the outer surface of the web, so as to form a loop when the needle is withdrawn. The effect of the subsequent heat-treatment is to lock the resulting loops in position, thanks to the bonding points created by the superficial melting of the thermobonding fibers that are in contact with each other or with other, non-thermobonding fibers. This bonding effect is obtained simply through the contact of the fibers with each other, with no need to perform any calendering. It should be noted that calendering should be avoided, because it has the effect of crushing the loops formed during the needle-punching, and therefore rendering the loops less accessible by the gripping elements of the male part of the fastener.

However, calendering may be necessary during the superficial melting of the thermobonding fibers and during the joining of the material according to the invention with a film, in a single operation.

The formation of the loops during the needle-punching with the fork needles or with the crown needles depends to a large extent on the position of these needles in relation to the direction of the fibers in the web. Because the web is advantageously formed through the use of a carder fed by a web feeder, the fork needles are positioned such that their slot is oriented essentially transversely in relation to the direction of motion of the web during the needle-punching. In effect, the web feeder positions the fibers in successive transverse layers prior to entry into the carder. Naturally, because of the longitudinal motion of the web and of the carder, the fibers undergo a slight reorientation. However, the efficiency of the needle-punching, in terms of loops, is improved if the slots of the needle have the above-mentioned orientation in relation to an orientation in the direction of motion of the web.

In a preferred variant of one embodiment, the needle-punching for the consolidation of the web is performed using barbed needles, at a ratio of 105 strokes/cm², and the needle-punching for the formation of the loops is performed using fork needles at a ratio on the order of 1 stroke/cm².

The needle-punched and thermobonded nonwoven, with loops on its surface, as obtained through the above-mentioned procedure, is wholly suitable for use as the female part of a self-gripping fastener. The density of the loops, the depth of the needle-punching, the proportion of thermobonding fibers, the titer of the fibers, the average length of the fibers, etc., are parameters that must be taken into consideration, especially as a function of the structure of the gripping elements of the male part of the fastener. Particularly with regard to a male part whose gripping elements are shaped like a nail-head, the female part likewise includes a needle-punched and thermobonded fabric nonwoven according to the invention, whose fibers have an average titer of 4.5 dtex and a fiber length of 60 to 100 mm, with the proportion of thermobonding fibers being on the order of 30%.

The present invention will be better understood through a reading of the following description of an embodiment of a needle-punched and thermobonded nonwoven with visible loops intended to constitute the female part of a self-gripping fastener, illustrated by the attached drawing, on which:

- Figure 1 is a diagrammatic cross-sectional view of two strips constituting a self-gripping fastener, located a certain distance apart from each other;
- Figure 2 is a diagrammatic cross-sectional view of the two strips in Figure 1, partially applied to each other;
- Figure 3 is a side view of a barbed needle;
- Figure 4 is a side view of a fork needle;
- Figure 5 is a diagrammatic representation of the manufacture of a needle-punched and thermobonded nonwoven with visible loops; and
- Figure 6 is a perspective view of a disposable diaper equipped with a fastener system.

In a well-known manner, a self-gripping fastener [1] includes two elements, in the form of two fabric strips or tapes [2] [3], one [2] of which has, on its surface, gripping elements [4] and the other [3] of which has, on its surface, loops [5]. This type of self-

gripping fastener is now entirely conventional, particularly the one known under the name Velcro.

The gripping elements [4] may have various shapes, such as hooks, harpoons, or nail-heads.

When one of the two strips [2] [3] is applied against the other, the gripping elements [4] of the first strip [2] penetrate the loops [5] of the second strip [3]. Because of the particular shape of the gripping elements [4] and the multiplicity of these elements, a natural hooking-together of the two strips [2] [3] is achieved, thanks to this penetration. Naturally, the two strips [2] [3] can be separated from each other. This separation is easy when a force, oriented obliquely in relation to the plane of the two strips, is applied in the direction of the arrow [F], as illustrated in Figure 2. Conversely, this force must be significantly higher in order to separate the two strips [2] [3] when the force is applied in the same plane as the two strips, along the arrow [G].

It should be understood that under these conditions, such a self-gripping fastener is often utilized in all of the applications involving the temporary joining of two parts, between which parts traction forces are applied primarily in the plane in which the said parts are joined.

This type of self-gripping fastener, known primarily under the name Velcro, is used in the areas of wearing apparel, furnishings, leisure items, footwear, etc.

This self-gripping fastener system is now starting to be offered in widely consumed disposable products, such as disposable diapers. A disposable diaper [6], as shown in Figure 6, consists of a single piece, including an impermeable outer sheet [7], an absorbent pad [8], and a permeable inner sheet [9], with the absorbent pad [9] *[sic; this reference number should be "8" – Tr.]* being sandwiched between the two outer and inner sheets [7] [9]. After the disposable diaper [6] has been placed in position, the two ends [10] [11] thereof are folded toward each other around the infant's waist. The disposable diaper is then fastened by joining these two ends [10] [11], customarily by means of a set of two adhesive tabs [12].

During the manufacture of a disposable diaper, the adhesive tab is first affixed along the lateral edges of one end [11] of the diaper [6], so that in order to fasten the diaper around the infant, the user needs only to detach part of the adhesive tab, which is applied to a protective strip, and apply the tab to the outer surface of the other end [10].

In the area of adhesive tabs, manufacturers have provided a wide variety of solutions.

Within the context of the present invention, the system of adhesive tabs for fastening such a disposable diaper [6] is replaced by a self-gripping fastener system.

More specifically, the goal of the present invention is to provide a material that is suitable for forming the female part of a self-gripping fastener, i.e., the part that includes visible loops on one surface.

Traditionally, in known self-gripping fasteners, this female part consists of a knitted fabric, such as jersey, whose knitting procedure, thanks to a subsequent brushing and scraping treatment, causes loops to appear on the surface.

For application in a disposal product, such as a disposable diaper, the use of such a textile substrate would be prohibitively expensive.

In a characteristic manner, according to the invention, the material used to form the female part of the self-gripping fastener is a needle-punched, thermobonded nonwoven that includes fibers having an average length of more than 50 mm, a proportion of thermobonding fibers of at least 20%, and loops, as produced by needle-punching, on one surface.

The applicant has observed that the anchoring of the loops in the structure of the needle-punched nonwoven can be obtained with fibers that are sufficiently long, and, in any event, that have an average length of at least 50 mm, and through the bonding of these fibers, as obtained through the dual effect of needle-punching and thermobonding, with the proportion of thermobonding fibers being at least 20%. Thanks to such an anchoring, when the two male and female parts of the self-gripping fastener are separated, the defibration of the loops is limited, thereby enabling the subsequent reuse of the female part.

Figure 5 illustrates the procedure for the manufacture of such a nonwoven.

The fiber web [13] is obtained in the conventional manner, with the aid of a web feeder and a carder. For example, the web consists of 70% polyester fibers and 30% copolyester fibers. The copolyester fibers are thermobonding fibers whose melting point is lower than that of the polyester fibers.

In one specific embodiment, the web [13] consists of 35% polyester fibers with a titer of 3.3 dtex, 35% polyester fibers with a titer of 6 dtex, and 30% copolyester fibers with a titer of 4.4 dtex. The average length of these three types of fibers is 60 mm. The fiber web [13] initially passes through a first single-stroke needle-punching station [17] equipped with traditional barbed needles, as shown in Figure 3. These needles [14]

include, on each of their edges [15], a series of notches [16] distributed around the periphery of the needle [14]. When the needle [14] penetrates the fiber web, the notches [16] hook the fibers and move them through the said web. This displacement is a function of the penetration of the needle in relation to the substrate of the web.

In one specific example of an embodiment, this first needle-punching station [17] has 5,666 needles per linear meter. These needles are Type 38 RB 3.5-inch needles, with a needle-punching density of 55 strokes/cm² and penetration of 9 mm.

This first operation produces a preconsolidation of the web.

The consolidated web [13'] then passes through a second needle-punching station [18], which is a dual-stroke station. In a first part [18a] of the said station, the consolidation of the web [13'] is continued, by means of traditional double-sided needle-punching with the aid of barbed needles [14].

In one specific example of an embodiment, this first part [18a] of the second needle-punching station [18] includes, on its first surface, which corresponds to the stroke of the first station [17], 4,266 needles per linear meter. These needles are traditional Type 36 R 3-inch barbed needles [14]. The needle-punching density is 25 strokes/cm², with a penetration of 14 mm. On the other side, the station [18] is likewise equipped with 4,266 needles per linear meter. These needles are Type 38 RB 3.5-inch needles. The needle-punching density is 25 strokes/cm², with a penetration of 9 mm.

In a very specific manner, the second part [18b] of the second needle-punching station [18] is equipped on one side with fork needles [19], as shown in Figure 4. These are needles whose free end [20] is divided into two parallel parts [20a] [20b], like a fork, defining between them a slot [21].

When the needle penetrates the web, one or more fibers are drawn along by the end [20] of the fork needle [19], with the said fiber or fibers being lodged in the slot [21]. The penetration of the fork needle [19] is such that the fiber or fibers that are drawn along by the said needle are moved beyond the surface of the web [13'] and form loops [22] on the side [23] opposite the side [24] located immediately opposite the needles [19] in part [18b] of the second needle-punching station [18].

According to the applicant, the penetration of the fork needles [19] should not exceed 14 mm, in order to produce loops that are acceptable in the intended application.

Moreover, so as to increase the effectiveness of the capture by each fork needle [19] of the fibers that constitute the web [13], the said needles [19] are advantageously

seated in the needle board such that the slot [21] is oriented essentially transversely in relation to the general direction of motion of the web [13']. Thanks to this specific arrangement, the slot [21] has the highest probability, with each stroke, of catching one or more of the fibers of the web. This result is obtained under the above-mentioned conditions, due to the fact that the general direction of the fibers, after webbing and carding, is essentially transverse in relation to the direction of motion of the said web.

In one specific embodiment, the fork needle [19] are Type 76 OVG needles. The needle-punching density is relatively low: on the order of, or slightly less than, one stroke/cm², with a penetration on the order of 14 mm.

At the two needle-punching stations [17] [18], the needle-punching speed is set to 1,054 strokes/minute, with a forward speed of 18 meters/minute for the fiber web and a needle-punching pitch of 17 mm.

A web surface [23] can be obtained that is homogeneous in terms of the creation of the loops [22]. A non-homogeneous implantation can also be obtained, with an effect consisting of a transverse stripe, simply by equipping part [18b] of the second needle-punching station [18] with a number of fork needles [19] that is lower than the maximum number for the board. For example, with 4 rows of needles, an effect consisting of designs with alternating stripes spaced at regular intervals can be obtained on the surface [23] of the web [13'].

After passing through this second needle-punching station [18], the web [13"] undergoes heat-treatment, without either calendering or crushing, at a temperature high enough to produce the superficial melting of the thermobonding fibers.

This heat-treatment is applied, for example, by causing the web [13"] to pass continuously through an oven [25]. The oven may be an oven with a hot-air flow: for example, a pulsed-air oven 8 meters long, with the air at a temperature of 205°C and with the web [13"], at the speed of 18 meters/minute, remaining in the oven for approximately 30 seconds.

Although no pressure is applied to the web [13"] when the thermobonding fibers are superficially melted, it should be noted that the nonwoven [26] exiting from the oven [25] includes a multiplicity of bonding points at the locations of contact, either between the thermobonding fibers [13] themselves or with non-thermobonding fibers. These bonding points are produced by the simple contact of the fibers with each other.

In addition to allowing the consolidation by means of the conventional needle-punching, these bonding points make it possible to anchor, inside the web [26] *per se*, the free ends of the fibers forming the loops [22].

The needle-punched and thermobonded nonwoven [26] with visible loops is implemented as the female part [3] of a self-gripping fastener [1], whose gripping element [4] in the male part [2] consists of elements shaped like a nail-head.

Rupture resistance tests have been performed in accordance with the NF G 91-106 standard. For this purpose, two test pieces were created: one for the nonwoven [26] according to the invention, in the form of a rectangle measuring 150 mm x 40 mm, and the other for a male strip [2] 120 mm long. A 30 mm segment of the male strip was applied to the looped surface of the nonwoven, with each element being placed between the jaws of a dynamometer, 200 mm apart. The said jaws were displaced at a speed of 100 mm/minute, and a measurement was taken of the mean resistance and the mean elongation obtained until the male strip and the nonwoven were separated. Mean resistance of 20 N was obtained, with mean elongation of 7%.

In the envisioned application of the nonwoven [26] as the female part of a self-gripping fastener for disposable diapers, the nonwoven in question may be present in any of several forms. It may consist simply of a part placed on the outer impermeable sheet [7] of the diaper [6] at its end [10], sized and located so as to be exactly opposite the male strip that, in conjunction with it, forms the self-gripping fastener. It may also be in the form of a continuous strip located transversely over the entire width of the end [10] of the diaper [6], serving as the female part for the two male fastener strips on the two lateral edges of the diaper.

Depending on the specific form of the gripping element [4], the mean titer of the fibers should be determined so as to obtain sufficient efficiency of the self-gripping phenomenon. According to the applicant, this titer may vary between 1.7 dtex and 17 dtex, depending on the surface mass of the nonwoven. As in the specific example of an embodiment described hereinabove, the use of fibers with a lower titer may improve the coverage of the nonwoven.

An increase in the proportion of thermobonding fibers in the mixture would have the effect of improving the resistance of the fibers, but would also increase the rigidity of the resulting nonwoven [26].

The present invention is not limited to the embodiment that has been described as a non-exhaustive example. In particular, the nonwoven according to the invention may be

used in applications for disposable products other than disposable diapers, for which the option of frequent reuse is unnecessary.

For example, in the area of domestic tools, such as rotary sanders, the nonwoven according to the invention may be applied to the smooth side of each abrasive disk, and may cooperate with the male elements with which the rotary base of the sander is equipped. Thus, the use of mechanical means for securing the abrasive disk to the base is avoided.

Furthermore, the fork needles can be replaced by other types of needles, including, in particular, so-called crown needles, whose general structure includes three edges, similar to those of the needle shown in Figure 3, but with only three notches, all located the same distance from the end of each needle, whose action is similar to that of three fork needles working together.

Claims

1. Material intended to form the female part of a self-gripping fastener, characterized in that it consists of a needle-punched and thermobonded nonwoven that is composed of a mixture of fibers having an average length of at least 50 mm, with a proportion of at least 20% thermobonding fibers, and that has, on one surface, loops formed during the needle-punching.
2. Material according to Claim 1, characterized in that the average titer of the fibers is between 1.7 and 17 dtex.
3. Material according to either Claim 1 or Claim 2, characterized in that the average length of the fibers is between 60 and 100 mm.
4. Material according to any one of claims 1 through 3, characterized in that the nonwoven has a surface mass on the order of 100 g/m²; the mean titer of the fibers is on the order of 4.5 dtex; and the proportion of the fibers in the mixture is on the order of 30% copolyester fibers and 70% polyester fibers.
5. Procedure for the manufacture of a material having a base of a needle-punched, thermobonded nonwoven intended to form the female part of a self-gripping fastener, characterized in that it consists of:

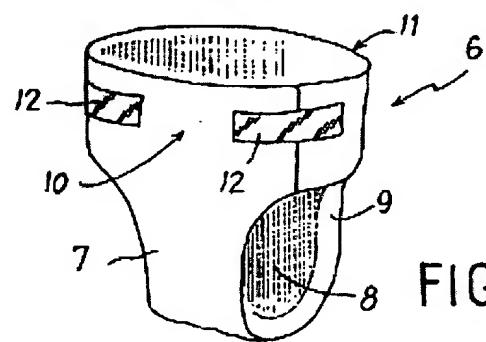
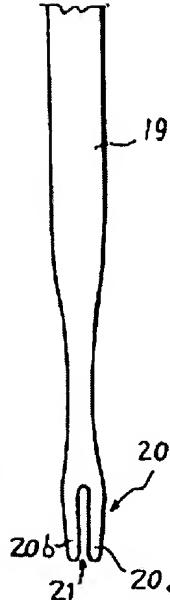
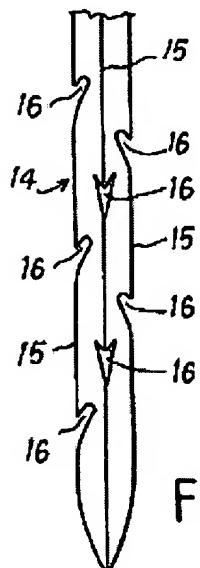
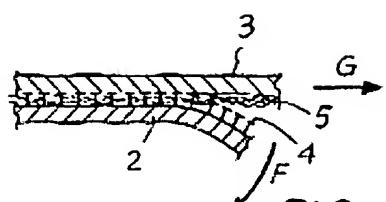
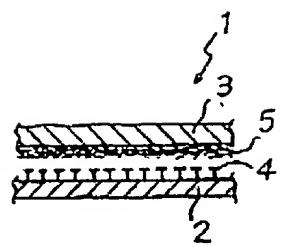
- a) forming a web of fibers [13] starting from a mixture containing a predetermined proportion of thermobonding fibers;
- b) needle-punching the said web using conventional needles [14] for the consolidation of the web and with fork needles [19] or crown needles for the formation of loops [22] on the surface, and
- c) heat-treating the needle-punched web, at a temperature high enough to produce the superficial melting of the thermobonding fibers.

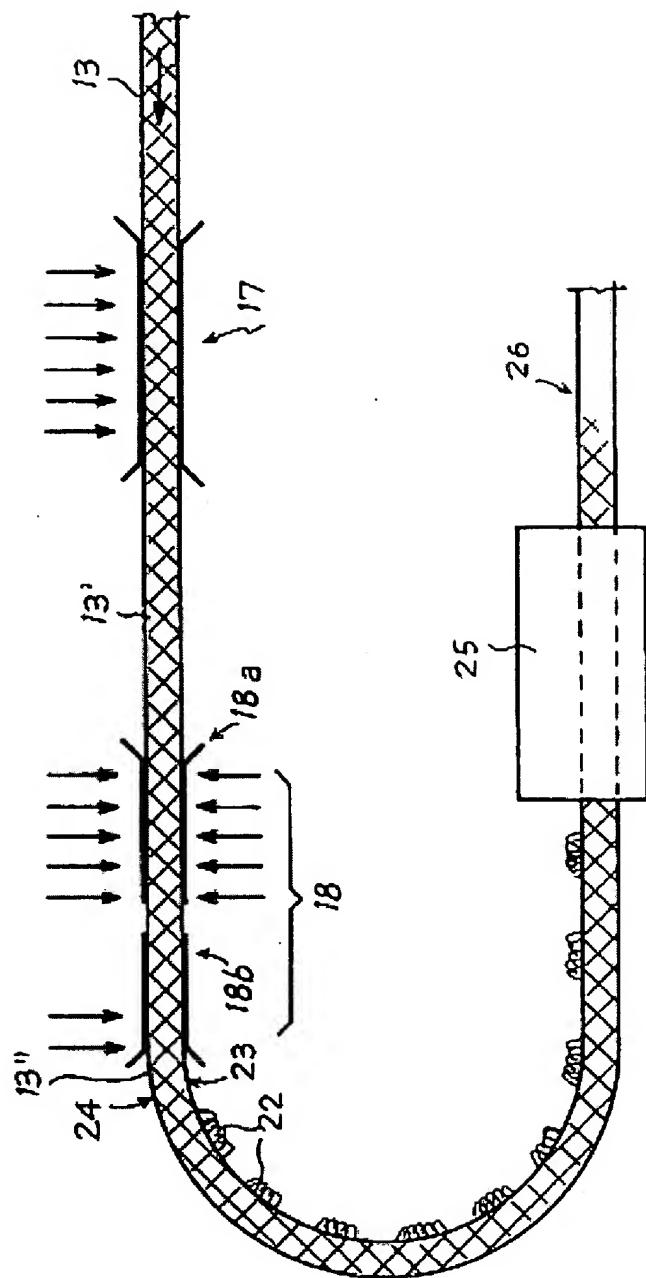
6. Procedure according to Claim 5, characterized in that because the web is formed using a carder fed by a web feeder, the fork needles [19] are located such that their slot [21] is positioned essentially transversely in relation to the direction of motion of the web during the needle-punching.

7. Procedure according to either Claim 5 or Claim 6, characterized in that the needle-punching for the consolidation of the web is performed using barbed needles at a ratio of 105 strokes/cm², and the needle-punching for the formation of the loops is performed using fork needles at a ratio on the order of 1 stroke/cm².

8. Procedure according to any one of claims 5 through 7, characterized in that the heat-treatment is performed by calendering the needle-punched web and a thermoplastic film, so as to obtain simultaneously the thermobonding of the nonwoven and the joining of the nonwoven [and] the film.

9. Self-gripping fastener consisting of a male part whose gripping elements are shaped like a nail head, and whose female part is a needle-punched, and thermobonded nonwoven with visible loops according to Claim 1, whose fibers have an average titer of 4.5 dtex and a fiber length of 60 to 100 mm, with the proportion of thermobonding fibers being on the order of 30%.





FIG_5

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The manufacturing procedure consists of:

- forming a web of fibers [13] starting from a mixture containing a predetermined proportion of thermobonding fibers;
- needle-punching the said web using conventional needles for the consolidation of the web and with fork needles or crown needles for the formation of loops [22] on the surface, and
- heat-treating the needle-punched web, without calendering, at a temperature high enough to produce the superficial melting of the thermobonding fibers.

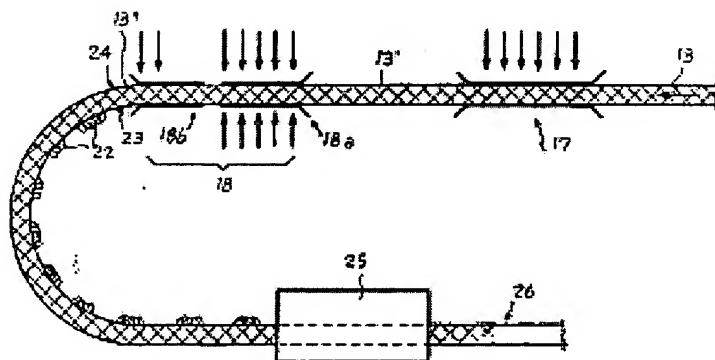


FIG. 5

DOCUMENTS CONSIDERED RELEVANT

Category	Document citation, with an indication, as necessary, of the pertinent portions	Affected claims
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CLASSIFICATION OF THE APPLICATION

(International Class 6)

D04H 11/08
 D04H 1/46
 A61F 13/62
 A44B 18/00

TECHNICAL FIELDS SEARCHED

(International Class 6)

D04H

A61F

A44B

The present report was prepared for all of the claims.

Search location: THE HAGUE

Search completed on (date): October 28, 1999

Examiner: S.V. Beurden-Hopkins

CATEGORIES OF THE CITED DOCUMENTS

- X: Particularly relevant, in and of itself
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- E: Patent document bearing a date prior to the filing date, but which was published on or after the filing date
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- L: Cited for other reasons
-
- &: Member of the same family; corresponding document

**SUPPLEMENT TO THE EUROPEAN SEARCH REPORT
RELATING TO EUROPEAN PATENT APPLICATION No.**

EP 96 49 0047

The present supplement indicates the members of the family of patents relating to the patent document cited in the foregoing European Search report.

The said members were present in the automated file in the European Patent Office as of the following date: October 28, 1999.

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For all information regarding this supplement, see the Official Journal of the European Patent Office, No. 12/82.



Morningside Evaluations and Consulting

TRANSLATOR CERTIFICATION

I, a translator fluent in the French and English languages, on behalf of Morningside Evaluations and Consulting, do solemnly and sincerely declare that the following is, to the best of my knowledge and belief, a true and correct translation of the document described below, in a form that best reflects the intention and meaning of the original text.

MORNINGSIDE EVALUATIONS AND CONSULTING



Signature of Translator

H.B.J. Clifford
ATA Reg. No. 212043
Name of Translator

Date: June 18, 2004

Description of Document Translated:

European patent application No. EP 0 780 505 A2, for Female part of a self-gripping fastener made of a nonwoven, procedure for its manufacture, and the grip-fastener thus obtained.